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East African Agricultural Research Institute

AMANI

Report for the year 1947

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EAST AFRICAN AGRICULTURAL RESEARCH INSTITUTE*

AMANI

Report for the year 1947

STAFF LIST AS AT 31st DECEMBER, 1947

Director, Vacant.

Plant Pathologist, H. H. STOREY, M.A., Ph.D., F.R.S. (seconded to Colonial Office).

Assistant Plant Pathologist, R. F. W. NICHOLS.

Entomologist, Vacant.

Soil Chemist, D. W. DUTHIE, M.A., B.Sc., Ph.D., F.R.I.C. (Acting Director).

Biochemist, R. R. le G. WORSLEY, A.R.C.S., B.Sc., Ph.D. (seconded to Veterinary Research Laboratory, Kenya).

Plant Physiologist (1), F. J. NUTMAN, D.Sc., D.I.C. (seconded as Director, Clove Research Scheme, Zanzibar).

Plant Physiologist (2), J. GLOVER, M.Sc.

Geneticist, L. R. DOUGHTY, B.Sc. (seconded as Director, Cinchona Research Organization to 31st August, then as Principal Scientific Officer, Fertilizer Experiments Scheme, E.A. Agriculture and Forestry Research Organization).

Botanist, P. J. GREENWAY, F.L.S.

Junior Chemist, Vacant.

Secretary, Vacant.

Assistant Secretary and Librarian, Miss P. M. LEAKE, B.A.

Superintendent of Plantations, L. M. FERNIE (seconded to Department of Agriculture, Tanganyika).

Assistant Superintendent of Plantations, W. B. MAY.

OFFICERS OF THE FERTILIZER EXPERIMENTS SCHEME, E.A. AGRICULTURE AND FORESTRY RESEARCH ORGANIZATION, WHO ARE WORKING IN AMANI LABORATORIES.

Soil Chemist, I. W. M. A. BLACK, B.Sc., Ph.D., A.I.C.T.A. (seconded from Nyasaland).

Soil Chemist, H. F. BIRCH, B.Sc., Ph.D.

* *Known as the East African Agricultural Research Station prior to* 1944. *The Institute was absorbed into the East African Agricultural and Animal Forestry Research Organization on the* 1*st January,* 1948.

INTRODUCTION

1. The annual report for 1946 opened with the statement that it would be the last annual report of this Institute, and the publication of a further report thus requires an explanation. The formal absorption of the Institute into the East Africa Agriculture and Forestry Research Organization was postponed until 1st January, 1948, although the two have been closely inter-related since November, 1947, when Dr. B. A. Keen, F.R.S., assumed duty as Director of the latter organization. Amani is now being used as the temporary technical headquarters of E.A.A.F.R.O., the policy being meanwhile directed by Dr. Keen from the High Commission Offices in Nairobi. A site for new headquarters has been acquired at Muguga, about 12 miles from Nairobi, and the erection of laboratories and houses will be started in the near future. A brief account of the transition period is given below.

2. At the 1946 research conference in Nairobi on agriculture, animal health and forestry, it was recommended that a better co-ordination of work on these subjects could be attained by setting up an organization with wider terms of reference than those of Amani, and this principle was accepted by the Colonial Office and by the East African Governments. Accordingly, plans were drawn up for the establishment of the East Africa Agriculture and Forestry Research Organization, which will have its headquarters near Nairobi and will work in collaboration with the East African Veterinary Research Organization in matters which concern both groups of research workers. Great emphasis was laid on the desirability of having the headquarters of these two research organizations near each other, since personal contacts between research workers give the best assurance of scientific collaboration. At the same time it was realized that work on each branch of agricultural and forestry research must be carried out in the district most suited to it, and that centralization should be reduced to the minimum. Thus, the main purpose of the new headquarters will be to provide an administrative centre, and any specialized and expensive laboratory facilities required by the staff. Much of the research will be done by project teams, working in the area where the particular problem can best be studied, with their local headquarters on, or adjacent to, the appropriate Departmental experimental station whenever possible. In this way close integration of the research, technological, and practical aspects of the problem under study will be obtained.

3. It was clear that the planning and establishment of this new research organization would present major technical and administrative difficulties, and in consequence it was decided that its Director should be appointed before the scheme actually comes into being, in order that he could guide the scientific lines of policy and ensure that it was in accordance with the problems involved and with the administrative plans for the development of East Africa. It was extremely fortunate that Dr. B. A. Keen, F.R.S., Assistant Director of Rothamsted Experimental Station, and Scientific Adviser to the Middle East Supply Centre from 1943 to 1945, decided to accept this post,

and his appointment was announced at a research conference in Nairobi in July, 1947. He had already toured the four East African dependencies which would be immediately concerned with the new research scheme—Kenya, Uganda, Tanganyika and Zanzibar—and at this conference he put forward his first impressions of the major scientific and organization problems.*

4. At the organization session of this conference it was agreed that there is urgent need to conduct extensive experiments on the effects of artificial fertilizers with special reference to phosphates, and that the territorial departments at their present strength are not in a position to undertake all the work involved. Accordingly it was recommended that a field project team should be set up immediately to undertake this work in collaboration with the Departments of Agriculture. As the Cinchona Research Organization was to be discontinued at the end of August, it was suggested that its Director, Mr. L. R. Doughty, should be in charge of this field team and that the staff of the Cinchona Research Organization should be utilized to carry out these fertilizer experiments.

5. This Fertilizer Experiments Scheme, a branch of the East Africa Agriculture and Forestry Research Organization, came into being on 1st September, 1947, and the laboratory and field sections of the fertilizer experiments scheme were able to start work immediately, since they took over the apparatus and equipment of the Cinchona Research Organization, and extra requirements were supplied on loan by Amani. Apart from adjustments of procedure on the administrative side this has not handicapped the work at Amani, and the experience in servicing field units which is now being gained will be of the greatest value when the new organization is fully established. There will, of course, be some difficulties in the transitional period, but the important point is that there has been no delay in making a start in the technical work of the new research scheme.

Staff

6. Mr. A. Glendon Hill, Director of the Institute since 1937, left for the United Kingdom in March, 1947, on leave pending retirement. During a large part of his tenure of office, Mr. Hill had the difficult task of guiding Amani through the war years, and of directing the special wartime investigations which were carried out. At the end of the war, Amani was left with only a skeleton scientific staff, but a renewed interest in agricultural research in the tropics had made it necessary for plans to be drawn up for expansion of the scope of Amani and for closer collaboration with the territorial Departments of Agriculture. Mr. Hill played an active part in this post-war planning, which has now led to the establishment of the East Africa Agriculture and Forestry Research Organization. We wish him all success in his new sphere of work in the Commonwealth Bureau of Horticulture and Plantation Crops.

7. In November, 1947, Mr. L. M. Fernie, Superintendent of Plantations, was seconded to the Department of Agriculture, Tanganyika. Miss P. M. Leake arrived from the United Kingdom in March, 1947, as Assistant Secretary and Librarian. Miss A. L. Alexander was appointed in October

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* *Vide* Agricultural Research Conference: Nairobi, 29-31 July, 1947. Proceedings of the Technical Session, E.A. Agricultural Journal, Vol. XIII, No. 2, October, 1947, pp. 67-87; and Agricultural and Forestry Research in East Africa. Proceedings of a Conference held in Nairobi on 29-31 July, 1947. Organization Session. Paper No. 2 (1948), East Africa High Commission Papers.

as Junior Chemist in the Soil Science laboratory, and is expected to arrive in East Africa in January, 1948. Mr. T. V. Greenwood, Engineer, acted as Secretary from June, 1946, until 1st September, 1947, and Miss P. M. Leake acted as Secretary from that date. Mr. W. B. May, Assistant Superintendent of Plantations, carried out the duties of Superintendent from November, 1947.

D. W. DUTHIE,

Acting Director.

APPENDICES

I.—SOIL SCIENCE: REPORT FOR THE PERIOD 1/1/47—31/12/47

Early in March, 1947, I took over the duties of Acting Director of the Institute and Editor of the *East African Agricultural Journal,* and the administrative work was complicated by the numerous staff changes which took place during the period under review. In consequence little time was available for work on soil problems, and the delay in appointing a Junior Chemist added to the difficulties. It was possible, however, to make some preliminary observations on the structure of soil crumbs, and a technique was worked out whereby even loosely-knit crumbs can be hardened in Canada Balsam, ground to a flat polished surface, and examined under the microscope with reflected light. It was hoped that thin sections, similar to rock slices, could be prepared for microscopic examination by transmitted light, but the most suitable binding material for this purpose (Kollolith) is unobtainable at present. No conclusions can yet be drawn from this preliminary micropedological investigation, but there seems to be a peculiar regularity in the structure of crumbs, even in widely differing soils, a common pattern consisting of quartz crystals embedded in a fine-grained matrix. The regular distribution of particles of different sizes suggests that very little binding material, such as organic matter, may be necessary and physical stability may be a major factor in crumb formation. It is possible, however, that a colourless form of soil organic matter plays some part in crumb formation. A crumb of red earth, which showed no sign of organic matter under reflected light, was heated gently in order to char any organic compounds, and the result was that all the aggregates were covered with a black deposit which disappeared on stronger heating. The presence of uncoloured organic substances in soil is mentioned by Kubiena in his book *"Micropedology"* (Collegiate Press, Ames, Iowa), and this may explain the fact that some tropical soils contain more organic matter than is reflected by the soil colour.

D. W. DUTHIE,

Soil Chemist.

II.—SYSTEMATIC BOTANY: REPORT FOR THE PERIOD 1/1/47—31/12/47.

The Herbarium:

During the year under review 101 accessions of botanical material totalling 2,868 specimens were received for identification from technical departments of governments, commercial firms, the planting community and private individuals in East Africa and the Belgian Congo. Of these the more important collections were from:—

Uganda: J. W. Purseglove, 153 (Agricultural Department); Members of the Forestry Department, 126.

Kenya: G. W. Jeffery, 54; D. C. Edwards, 59; A. Bogdan, 30 (Agricultural Department); Miss L. Frazer, 36 (Soil Conservation Service); J. P. Glasgow, 25 (Tsetse Research); P. R. O. Bally, 13 (Coryndon Memorial Museum); Miss B. Webster, 61.

Tanganyika: J. F. Hughes, L. T. Wigg and others, 519 (Forest Department); H. J. van Rensburg, 194 (Pasture Research); Mrs. G. Macoum, 30 (Flower Paintings); other flower paintings, 14 (King George V Memorial Museum); P. J. Greenway, 200 (E.A.A.R. Institute); W. J. Jepson and others, 31 (Agricultural Department); The Government Chemist, Police and Administration, 25.

Northern Rhodesia: C. G. Trapnell, 113 (Ecological Survey); P. J. Greenway (E.A.A.R. Institute) and J. P. M. Brenan, 593 (Imperial Forestry Institute).

Belgian Congo: F. L. Hendricks, 653 (Institut Nat. L'Etude Agric.).

Duplicate named specimens totalling 1,968 were distributed, the majority to the following institutions:—

The Royal Botanic Gardens, Kew	1,131
The National Herbarium, Pretoria	233
The Imperial Forestry Institute	192
Naturhistoriska Riksmuseet, Sweden	50
The Soil Conservation Service, Kenya	55
The Forest Department, Tanganyika	14
Miscellaneous institutions	277

Only 43 named specimens were received in exchange, of these 25 were orchids from the Conservator of Forests, Uganda.

Requests for the loan of specimens continue to be received from various institutions and specialists, and botanical material was loaned from the Herbarium to the following:—

The British Museum, London (Umbelliferae and Compositae); The Botanical Museum and Herbarium, Utrecht, Holland (Prof. C. E. Bremekamp, *Pavetta* 176 sheets); The Imperial Forestry Institute, Oxford (Messrs. J. P. M. Brenan and A. C. Hoyle, *Brachystegia* spp. etc.); The National Herbarium, Pretoria (Dr. R. A. Dyer, Euphorbiaceae); The Royal Botanic Gardens, Kew (*Saintpaulia,* Euphorbiaceae, Gramineae, Rubiaceae and negatives of photographs); The U.S. National Museum, Washington (E. P. Killip, Passifloraceae 97); The University of California (E. B. Babcock, *Crepis* spp. 12); miscellaneous correspondents in East Africa.

Some of this study material has already been returned, and thanks are due to the various specialists for naming and authenticating the specimens. The value of the collections in the Amani Institute Herbarium has been considerably enhanced by their studies.

About 2,000 determinations on plants from various collectors were made and reports and memoranda written on a wide range of subjects, such as the proposed Flora of East Africa; weeds; parasitic plants; fruits; timbers; drug plants, native medicinal and poisonous plants; grasses; pasture and browse plants; fibres; condiments, spices and beverage plants; essential oils, oils, fats and waxes; gums, dyes; bamboos; cover crops and green manure plants, etc. This information has been supplied to numerous correspondents in East Africa as well as to others in different parts of the world.

During the work of determining collections a further 9 type specimens were found in the Herbarium and 13 new species from the Institute were described and published. These new species together with those found during the year in the course of routine determinations now bring the total of known iso-types in the Amani Institute Herbarium up to four hundred and twenty.

In the course of the year 2,099 sheets have been filed in the Herbarium making a total of 56,349 specimens available for study.

Field Work:

I attended in Nairobi a conference on agricultural and forestry research held on the 29th to the 31st July. A note on *A Flora for East Africa* was presented, in which the need of a regional flora for East Africa was stressed and methods for preparing and publishing such a flora were suggested.

On the 1st August I left Nairobi by road for Livingstone, Northern Rhodesia, to join Mr. J. P. M. Brenan, Forest Botanist of the Imperial Forestry Institute, Oxford, who was on an official visit to the Forest Department of that territory collecting botanical specimens with the object of preparing a check list of the woody vegetation of Northern Rhodesia. I reached Livingstone on the 11th August, where I joined the Ecologist, Mr. C. G. Trapnell, and proceeded with him and Mr. D. Peters, Agricultural Officer, to the Mulobezi District of Barotseland.

In the company of these officers and Mr. Brenan various areas were examined as to their suitability for groundnut cultivation.

On our return to Livingstone about 10 days were spent in collecting in that district and examining the contents of the Forest Department's Herbarium that had been transferred from Ndola.

From Livingstone Mr. Brenan and I proceeded north to Beit Bridge at the southern end of the Luangwa River on the Great East Road visiting the Agricultural Department's headquarters at Mazabuka *en route.*

After several days at Beit Bridge we went to Broken Hill where we stayed with Mr. C. G. Trapnell and saw and discussed with him his work on the interpretation of aerial photographs of vegetation for ground surveys.

From Broken Hill we went to Mumbwa to examine two areas suggested as suitable for the cultivation of groundnuts. The economic timber resources of these areas were also examined, after which we returned to Broken Hill.

From Broken Hill we went to Ndola, visiting various places in the Copper Belt including Solwezi. Thence to Fort Roseberry and the western, northern and north-eastern shores of Lake Bangweulu. From Lake Bangweulu we went by way of Luwingu, Kawambwa and Kasama northwards to Abercorn, collecting on the way.

Several days were spent in the Abercorn District, after which we entered Tanganyika by way of Tunduma and Mbeya. Using Mbeya as a centre, trips were made into the Mporoto, Livingstone and Mbeya Mountains and to Tukuyu.

From Mbeya to Amani visits were paid *en route* to Mufindi, Iringa, Morogoro and the West Usambaras. Mr. Brenan and I visited members of the Forest Department and collected in the Magamba, Shume, Malindi areas of the West Usambaras.

On our return to Amani, after a few days spent in sorting our collections, three days were spent in demonstrating to Mr. Brenan the coastal vegetation between Moa and Pangani, after which we returned to Amani, where Mr. Brenan spent a week studying in the Herbarium and in the rain forest in the Amani District.

During our tours over 1,000 specimens were collected in quintuplicate amongst which we consider we have discovered at least three new genera and numerous new and little known species. Some considerable time will be required in working out our collections before the results are ready for publication and the specimens can be distributed.

Our thanks are due to the Conservator of Forests, Northern Rhodesia, and his staff, particularly Mr. R. G. Miller for arranging such interesting tours, and to those officers of the Administration whose districts in which we travelled, for hospitality and assistance; also to the Ag. Conservator of Forests, Tanganyika, Mr. L. G. T. Wigg, for allowing members of his department to show us the forests in their districts.

Publications:

"Yeheb," *E.A. Agric. J.* Vol. 12, pp. 216-219 (1947).

"A Veterinary Glossary of Some Tribal Languages of Tanganyika," *E.A. Agric. J.* Vol. 12, pp. 237-244 (1947).

"Mahogany in East Africa I—The Khayas," *E.A. Agric. J.* Vol. 13, pp. 8-14 (1947).

"Khat," *E.A. Agric. J.* Vol. 13, pp. 98-102 (1947).

P. J. GREENWAY,
Systematic Botanist.

III.—PLANT PATHOLOGY: REPORT FOR THE PERIOD 1/1/47—31/12/47

General

I went on vacation leave on 11th April and returned on 5th September, in time to do the final recording and harvesting of the cassava field trials and to lay down the next series of trials. During my absence Mr. W. B. May, Assistant Superintendent of Plantations, supervised all the routine field work in connection with the propagation plots at Amani and Kwamkoro.

Breeding cassava in an attempt to secure resistance to the mosaic and brown streak viruses and for general improvement of the crop continues to be the main work assigned to me; it has now reached such proportions that it is a full-time occupation. The general lines on which this long-term project is being carried out has been described in previous reports; there is therefore no need to recapitulate the details here. In the second part of this report the progress made since the breeding programme was started is summarised and the chances of ultimate success discussed.

Controlled hand-pollination of selected clones was carried out during the first two months of the year. Over 5,500 flowers were pollinated in this manner, the majority being second back-crosses to cassava from first back-cross inter-specific hybrids containing "blood" of the species *Manihot dichotoma*. *M. glaziovii* (ceara rubber), and "Tree" cassava. A series of double crosses between *M. dichotoma*—cassava hybrids x ceara—cassava hybrids was made, and a large proportion of these produced viable seeds. *M. catingae* and *M. melanobasis* flowered for the first time and both species were successfully crossed with cassava. A total of over 3,500 seeds was obtained from all crosses; 2,262 germinated, and of these about 2,000 seedlings have survived. They have been planted in the propagation plots on Kwamkoro Estate, six miles from Amani. The area of land in use there (about 12 acres) is completely planted up and it will be necessary to clear another 20-30 acres for future propagation and multiplication of seedling material. The general soil fertility of Kwamkoro is very low and it is necessary to apply manure and artificial fertilizers to ensure good growth.

Field trials, the primary object of which is to test for virus resistance under natural conditions, were continued on the land loaned to us by the Tanganyika Sisal Board at its Experiment Station on the plains at Mlingano, thirty miles from Amani.

A preliminary trial started in 1946 was terminated in March. Of the 226 clones in this trial 73 were retained for further testing in the next series of replicated trials. Two replicated trials containing 120 clones were harvested in September; only two of these withstood infection by both mosaic and brown streak; one of them is a first back-cross ceara hybrid and the other a second back-cross *M. dichotoma* hybrid. The latter has since proved to be completely sterile so that it is of no value for further breeding purposes. The ceara hybrid is fully fertile and it has been extensively used both as a male and female parent in back-crossing to cassava.

The current field trials were planted in October; they consist of one preliminary trial of 527 clones and four replicated trials carrying 240 clones. The area of land in use is a little more than six acres. Some of the blocks have been planted with cassava for three consecutive years; when the present trials are harvested this land will be planted with elephant grass and fallowed for two or three years.

It is not proposed to release any of the inter-specific hybrids until they have been fully tested and proved to be satisfactory in all respects. At the request of Dr. Bates of the Agricultural Department, Salisbury, planting material of 10 ordinary cassava varieties was supplied to the Cassava Corporation, Inyazura, Southern Rhodesia. Cuttings of a further 12 varieties were supplied to National Chemical Products Ltd., Germiston, for trial in the Transvaal. This company is interested in cassava as a source of raw material for the manufacture of alcohol. Six varieties were sent to the S.A. Sugar Experiment Station, Mt. Edgecombe, Natal.

Published as an appendix to this report are figures for the chemical analysis of fresh roots of species of *Manihot* and certain of the hybrid material, with an ordinary cassava variety included for comparison. These figures are of particular interest as they afford a guide as to what may be expected of particular crosses. On the whole the figures for the hybrids compare very favourably with those for the ordinary cassava variety and in some respects they are better, but the hydrocyanic acid content is rather high in some of them. I am indebted to Dr. H. F. Birch of the Chemical section for carrying out the analyses for me.

Sweet Potato Virus Disease. The vector of this disease still evades detection. None of the healthy plants put into the field between rows of diseased plants has contracted the disease so it may be assumed that the vector does not occur in this district. No further work on this disease is contemplated unless field infection becomes evident.

Review of work on cassava

It is now 10 years since breeding work was commenced on cassava and it seems appropriate to give a brief review of the progress made. As it takes a minimum of at least three years to raise and test one generation of seedlings, progress is relatively slow, but it is possible, even at this stage, to reach some tentative conclusions on the chances of ultimate success.

As I have indicated elsewhere (E.A. Agric. Jour. XII No. 3) I am firmly of the opinion that little is to be gained by continued intercrossing of the standard commercial cassava varieties. High yielding varieties have been produced by this means but most of them have proved to be highly susceptible to the two virus diseases prevalent in the main cassava growing areas of East Africa. In fact the evidence to date suggests that high yield and susceptibility are closely linked genetically. This supposition is strengthened by the fact that nearly all the highly disease resistant clones produced have been relatively poor croppers. For these reasons inter-specific hybridisation appears to offer the best chance for any marked improvement of the crop and it is on this that efforts are being concentrated.

A wide range of types is now in existence from crosses between cassava and *M. dichotoma, M. glaziovii, M. saxicola* and "Tree" cassava. The first series of F hybrids between cassava and *M. catingae* and *M. melanobasis* are still in the seedling stage and it will be another two years before anything is known about their behaviour. Both the latter species have been naturally infected by mosaic but this of itself does not render them entirely useless as potentially useful parents for breeding disease resistant types. I base this opinion on the behaviour of certain existing hybrids which have withstood natural infection in the field although they were bred from susceptible clones. In any case it is well worth while to persevere with *M. melanobasis* on account of the high protein content of the roots of this species.

M. dichotoma hybrids. Several first and second back-crossed hybrids of this species have withstood natural infection in the field. A few of these are completely sterile, some are pollen sterile, some ovule sterile and the rest are fully fertile. Their root systems are variable, ranging from completely woody to fully tuberous roots with varying amounts of fibre. The figures for the chemical analysis of hybrid No. 4397/1 compare very favourably with those for the ordinary cassava variety " Mbarika ". This hybrid is, however, a poor yielder and is therefore not suitable for release to cultivators. A third back-cross generation bred from these highly resistant clones is in the seedling stage. It is hoped that some at least of these will be both highly resistant and good yielders. Included in this batch are the double hybrids mentioned earlier, the second parent being a very high yielding but mosaic-susceptible ceara hybrid. It may prove necessary to carry the back-crossing to a fourth or even fifth generation in order to restore desirable agronomic characters, but if this should happen presumably a progressive diminution in disease resistance may be expected to occur.

Ceara hybrids. Most of the hybrids now being raised originate from a single first back-cross clone which has twice been tested in field trials and in both it has come through without contracting either disease; nor has it been infected by grafting tests. The prospects of this very valuable clone passing on resistance to its progeny are very encouraging. From the initial group of seedlings bred from it, two have withstood natural infection by both diseases. Both are rather slow growers but they both gave reasonably good yields under the conditions of the trial, and they would probably prove suitable for cultivation at elevations up to about 2,000 ft. a.s.l., but unfortunately the quality of the roots does not come up to the required standards. The roots of one of them have been analysed chemically (Hybrid No. 4318/22 in the appendix) and the figures compare very favourably with those obtained for the ordinary cassava variety " Mbarika ". Chemical analysis alone is not sufficient to determine culinary qualities. Those Africans who have tried these roots claim that they are indistinguishable from ordinary cassava when eaten as a vegetable, but that the flour prepared from dried roots makes a mushy porridge which they do not like. A firm consistency is apparently what is wanted. Other clones, of the same parentage, a great many of which are being raised, may prove to be better in this respect and if they are equally disease resistant they will be released.

A third back-cross generation from the above two clones is in the seedling stage and material from these seedlings will go into a preliminary trial during the coming year. The roots of this generation should be better in quality and comparable with ordinary cassava. Without being unduly optimistic it seems probable that it should not be necessary to continue back-crossing these ceara hybrids beyond this point in order to get good quality. With reasonable luck material fit for cultivation should be available within the next three years.

Some very heavy yielding ceara hybrids with, in some cases, roots up to 6 feet in length, have been produced, but without exception they have all proved to be susceptible to mosaic. The highest yielder produced so far gave an average of 70 lbs. of fresh edible root after one year's growth; left in the ground longer the yield would undoubtedly be much higher.* This is the clone being used in the double crosses in the hope that the factor for high yield will be incorporated with the high disease resistance of the second parent.

" Tree " cassava hybrids. On the whole the results obtained with this material have been disappointing from the disease resistance point of view. The original clone showed high yield resistance which was passed on to a proportion of the F_1, hybrids. Resistance fell off considerably in the first back-cross and only one clone has been retained for breeding purposes. Plants of a second back-cross generation from this clone are now on test in the current field trials. If none of them shows the desired degree of resistance further work with this material will be discontinued.

* The highest yield I am aware of was 218 lbs. of fresh root from a single plant of ordinary cassava; this was grown at the S.A. Sugar Experiment Station in Natal. The age of the plant was estimated at not less than 6 years.

M. saxicola hybrids. This species is itself highly susceptible to mosaic and so were the F_1 hybrids produced from it. A group of open-pollinated plants raised from these F_1 hybrids has, however, produced some individuals with high resistance. The very high hydrocyanic acid content of *M. saxicola* makes it worth while to persevere with these hybrids in order to produce bitter types, for which there is a demand. Hybridisation is therefore being continued with this material and if resistance breaks down an attempt to re-introduce it will be made by the double-cross method.

Appendix

Analyses by Dr. H. Birch of the fresh peeled roots of certain *Manihot* species and inter-specific hybrids.

Variety	H_2O Per cent.	HCN Mgm. per 100 gms.		Starch Per cent.		Crude Protein Per cent.		Fibre Per cent.
		Fresh	Dry	Fresh	Dry	Fresh	Dry	Dry
M. dichotoma ...	45·1	0	0	11·34	21	2·83	5·15	47·85
M. dichotoma hybrid No. 4397/1 (2nd Back-cross) ...	56·2	6·2	14	33·4	76	1·11	2·52	2·3
M. glaziovii	77·3	2·4	10	12·48	55	0·90	3·91	4·65
M. glaziovii hybrid No. 4318/22 (2nd Back-cross) ...	54·9	17·3	38	37·4	83	0·60	1·33	2·2
M. glaziovii hybrid No. 4332/2 (2nd Back-cross) ...	56·5	6·3	14	34·5	78	0·45	1·02	2·1
M. glaziovii hybrid No. 4332/2 (Flour)	15·3	0	0	63·99	76	2·73	3·22	3·1
M. saxicola	62·0	66·7	175	27·8	73	1·3	3·43	3·75
M. saxicola hybrid No. 43121/34 ...	51·9	5·7	12	38·5	80	0·52	1·09	3·3
M. melanobasis ...	69·1	27	87	21·5	70	2·03	6·55	3·2
M. catingae	46·9	15·1	28	15·34	29	1·69	3·19	48·05
Cassava " Mbarika "	60·6	1·6	4	30·3	77	0·38	0·95	2·95

R. F. W. Nichols,
Assistant Plant Pathologist.

IV.—Plant Physiology: Report for the period 1/1/47—31/12/47

I was on vacation leave from September, 1946 (and resumed duty on March 10th, 1947). During my leave I was fortunate in being able to visit Sir Frank Engledow, Professor Briggs, Dr. Childs and others at Cambridge; Sir Edward Salisbury, Sir Geoffrey Evans and Dr. Hubbard at Kew; Dr. Ogg, Dr. Keen, Dr. Penman, Dr. Morton at Rothamsted, and Dr. Storey, Secretary of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to

discuss with them problems related to drought. I would like to take this opportunity to express my thanks to them and to Professor Gregory of Imperial College, London, for valuable criticism and advice concerning a proposed programme of work on the "drought resistance" of food crops in East Africa.

A simple drought chamber such as those previously described in the Journal of Agric. Res. and J. Amer. Soc. Agronomy has been established at Amani to test seedlings of local maizes, sorghums and millets. Experiments in it have shown that many of the local sorghums from the dry Central Province of Tanganyika Territory are more resistant to soil drought than some maize. It was, however, much more difficult to demonstrate conclusively differences in soil drought resistance between "varieties" or sorghums, possibly because of the variable genetic nature of the local material. Nevertheless, there was obtained some preliminary information that some of the most popular sorghums and millets in the Central Province were slightly more resistant than other less popular varieties. This work, however, requires confirmation. Possible differences in resistance to atmospheric drought were also observed but could not be judged with confidence as no equipment was available to maintain the air in the chamber at constant low humidity. This work has lapsed until the assistance of a plant-breeder is made available.

Coincident with the drought chamber test I also started to measure the water-requirements of some local maizes and sorghums. Particular attention is being paid to fast-growing varieties so that if necessary drought-evasion may be considered as an alternative to drought-resistance.

Studies in the nutrition of maize in sand and solution culture have also been started. They were first directed towards finding if phosphate had any effect in increasing the size of the root-system or decreasing the top-root ratio. Preliminary results show that the effect of phosphate is intimately connected with the nitrogen supply and that increases in concentration of phosphate were not effective in increasing root weight or volume unless the balance between N and P was maintained. In general, in the presence of adequate nitrogen, increases at low levels of phosphate increased root weight and volume and also greatly increased the weight of tops. The net gain due to increases in phosphate at low levels was therefore an increase of the top-root ratio. Further increases of phosphate had no effect as the N P balance was disturbed. These experiments are being continued.

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